MARINE ALGAE FROM LAYSAN ISLAND WITH ADDITIONAL NOTES ON THE VASCULAR FLORA

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The Leeward Hawaiian Islands are composed of a chain of nine islands and reefs that extend northwest from Kauai. All of these islands are uninhabited with the exception of Midway, Kure, and French Frigate Shoal. For further details on the separate islands and reefs, see Bryan (1942).

Laysan Island, one of the Leeward Hawaiian Islands, is located about 790 nautical miles northwest of Honolulu at 25° 42' 14" North Latitude, 171° 44' 6" West Longitude. This low coral island is about one and three quarters miles in length and one mile wide with a large salt-water lake occupying the center of the island. The water in this lake is about twice as saline as "normal strength" sea water. The west, north, and south rims of the island reach heights of thirty to forty feet before sloping downward toward the central lake, but the south rim is only about ten feet above sea level. At present this island is a wildlife refuge under the jurisdiction of the Bureau of Sport Fisheries and Wildlife, United States Fish and Wildlife Service, Department of Interior.

Lamoureux (1963), from which all of the above description of the island is taken, gives a short résumé of the topography and history pertinent to the vegetation of this island. He presents an up to date listing of all the species of vascular plants, with their dates of collection or observation, that are recorded from Laysan, including those from his own collections. While he gives the current status of the vascular plants from Laysan, there are no recent papers on the non-vascular plants. Bryophytes have never been reported from Laysan. This is partly due to the unsuitable sandy substratum that covers the major portion of the island. The fungi are another group that has never been reported on, probably because no qualified person familiar with this group has ever visited the island. The author feels that many fungi occur in the soils and in the fecal matter of the thousands of birds that inhabit this island, also that marine fungi may be found near shore.

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Past published listings of the algae from Laysan are based solely on Schauinsland's collections during 1896-1897 which were identified and published in both Reinbold (1899) and Lemmermann (1905). Schauinsland spent three months on the island and made extensive collections of the algae, particularly concentrating on the phytoplankton. He listed (1899) twenty-three species of marine benthic algae which had been determined by Reinbold (1899). Later, Lemmermann published a very comprehensive paper (1905) on the algal flora of the Hawaiian Islands. His paper lists forty-five species of marine algae based on Schauinsland's collections from Laysan including nineteen of the twenty-three species listed by Schauinsland in his 1899 paper. Also included by Lemmermann are fifty-one species of marine phytoplankton collected by Schauinsland between Laysan and Oahu. The specimens collected by Schauinsland were not seen by the author. In 1918 MacCaughey published a treatment of all the known algae from the Hawaiian Islands which is partly based on Lemmermann's list.

In the spring of 1923, the Tanager Expedition visited Laysan for one month. Mr. Edward L. Caum, one of the botanists on this expedition, reported in his field notes that twenty-six algal collecting stations were made on or near this island--twenty stations along the shore of the island, five from dredging stations in 20-40 meters of water, and one station in the salt-water lake. Mr. Caum's original field notes are in the possession of the Bishop Museum, Honolulu, Hawaii. There is no species list of the algae found from these stations in those notes nor in any of the other published works concerning this expedition. Forty-three species or varieties of algae from Laysan collected by the Tanager Expedition were found in the Herbarium at the B. P. Bishop Museum. They are included in the present paper. The specimens of vascular plants collected from Laysan during the Tanager Expedition and some of the specimens of Schauinsland's may be found in the Herbarium at the Bishop Museum.

In 1961 Dr. Charles H. Lamoureux collected a few marine algae which were not reported in his 1963 paper. To the author's knowledge, no other algal collections were made on this island between the time of Dr. Lamoureux's visit and the author's visit.

Past records of algal collections are also available from two other islands in the Hawaiian Leeward Group. Howe (1934) lists fifteen species of marine algae collected by Dr. Paul C. Galtsoff from Pearl and Hermes Reef. The other record is Buggeln's recent paper (1965) listing thirty-four species of marine algae collected by Dr. Lamoureux from Midway Island.

Through the courtesy of both the Hawaii State Fish and Game Division under the Department of Land and Natural Resources and the United States Coast Guard, the author was able to visit Laysan Island in December 3-10, 1963, making extensive collections of both the vascular plants and the marine benthic algae. Water samples for salinity analyses were also obtained from the salt-water lake and along the seashore.

The main objective of this paper is to provide an up to date listing of all the marine algae collected from Laysan Island, which consists of collections by Schauinsland (1896-1897), Tanager Expedition (1923), Lamoureux (1961) and the author (1963). The encrusting coralline algae collected by the Tanager Expedition are excluded; otherwise this list, together with Lemmermann's paper (1905), provides a complete listing of all the algae both benthic and planktonic thus far recorded from Laysan. Also included in this paper is a list of the twenty-two vascular plants collected by the author in December, 1963, with some miscellaneous notes pertinent to the terrestrial flora. A brief discussion and records of the salinity data obtained are also included in this paper.

Acknowledgment

The author is grateful to Dr. Charles H. Lamoureux, Botany Department, University of Hawaii, who critically read over the manuscript offering helpful suggestions to the author, and who furnished the determinations of the two species of vascular plants which were unfamiliar to the author as well as his verification of the author's determinations of the other vascular plants. He is also grateful to Mr. "W" Jan Newhouse, Dole Pineapple Company, who extended his help on certain algal problems and for his determination of the blue-green algae of the Tanager Expedition. The author is indebted to Dr. Maxwell S. Doty, Botany Department, University of Hawaii, and to Dr. Albert J. Bernatowicz, General Science Department, University of Hawaii, who made their personal libraries freely available to him. At this time he also wishes to thank both Mr. Ronald Walker, wildlife biologist, Hawaii State Fish and Game Division, and Dr. Nixon Wilson, acarologist, B. P. Bishop Museum, who made the trip to Laysan with the author and willingly offered him their help whenever he was in need of it.

He is also indebted to Dr. Llewellya H. Colinvaux, Department of Botany and Plant Pathology, Ohio State University, who provided the determination of one of the species of Halimeda: to Dr. Francis Drouet, Academy of Natural Sciences, Philadelphia, who provided the

species determinations of all the blue-green algae collected by both Dr. Lamoureux and the author; to Dr. William J. Gilbert, Department of Biology, Albion College, who provided many of the species determinations within the Chlorophyta; to Dr. George J. Hollenberg, Professor Emeritus of Biology, University of Redlands, for his determination of the species of Polysiphonia; to Miss Marie Neal, Bishop Museum, who provided the identification of the seeds; to both Mr. Tim O'Callaghan, Botany Department of Hawaii, and Mr. David Hashimoto, United States Bureau of Commercial Fisheries, who analyzed the salinity samples recorded in this paper; to Mr. Jan Chock, Botany Department, University of Hawaii, who prepared the map (Fig. 1); and to Miss Harriet Koyama, Botany Department, University of Hawaii, who typed the final draft of this manuscript for the author.

MARINE ALGAE

In making the algal collections and observations, the author walked along the shore around the island looking for different types of algal habitats and made extensive collections from each area. Seven water samples were taken in reference to algal collection areas along the shore. The collection from each habitat was placed in a separate plastic bag and preserved with 10% formalin in sea water.

The first step undertaken in identifying these algae was to sort those from each collection into the respective genera, giving each entity from each collection a number. The collections made by Dr. Lamoureux are permanently recorded in Dr. Maxwell S. Doty's notebook number 62 with the numbers ranging from 19577-19593; while the author's collections are permanently recorded in his own notebook with collection numbers ranging from 509-609. All of the author's and Dr. Lamoureux's specimens, except those specimens which were sent abroad to be identified, are deposited in Dr. Doty's herbarium in the Botany Department at the University of Hawaii.

Other references, aside from those cited in the bibliography, which proved of immense value in the determination of the species within the Chlorophyta and Phaeophyta were Dr. William J. Gilbert's unpublished field manual of Hawaiian Chlorophyta and the unpublished manuscript on the Hawaiian Phaeophyta by Dr. Maxwell S. Doty and Mr. "W" Jan Newhouse.

The following is a list of the major habitats from which the collections of algae were made. See Fig. 1 for the locations of each of the recent algal collecting stations. The numbers preceding the description of each habitat are the station numbers which are listed consecutively to simplify citation of the habitats in the species list. Other habitats where only one species was found are not designated by a station number since habitat can be fully described under the appropriate species.

Collections made by Schauinsland, 1896-1897

STATION 1 - Laysan Island (Schauinsland (1899) and Lemmermann (1905) did not elaborate on the particular area of the island from which the algae were collected).

Collections made by the Tanager Expedition, April, 1923

STATION 2 - Laysan Island (few habitat descriptions were available on herbarium labels).

Collections made by Lamoureux, September, 1961

STATION 3 - On coral ridge on south and southwest sides of island (19579-19584).

STATION 4 - Beachdrift on the north shore of island (19585-19593).

Collections made by Tsuda, December, 1963

STATION 5 - On reef, about one meter deep, near shoreline on northwest side of island about two hundred meters south of main boat entrance. Reef flat largely barren and very brown in color. Fig. 3 shows this reef flat during high tide (509-519).

STATION 6 - On two large coral heads which appeared completely green in color from algal growth of Ulva and Enteromorpha. These coral heads were exposed during low tide (520-521).

STATION 7 - On slightly wave-washed coral ledge on west side of island. Salinity recorded as 35.01 °/oo (522-533).

STATION 8 - In a long shallow tidepool, about half a meter deep, which runs parallel to the shore at the northernmost point on the large coral ridge (about 250 meters long) on southwest side of island. At low tide, this tidepool is easily accessible, whereas at high tide it is almost impossible to reach without being washed over the seaward ledge. Fig. 2 shows this coral ridge during high tide. Salinity recorded as 35.19 °/oo (534-539).

STATION 9 - In tidepool on southernmost point of this same large coral ridge as in "Station 8" (540-576).

STATION 10 - Beachdrift on northwest shore (577-592).

STATION 11 - On wave-washed coral ledge on northeast side of island. Salinity recorded as 35.17 °/oo (593-606).

The following is an annotated list of all the blue-green, green, brown and red algae that were collected from Laysan Island by the four collectors cited above. The station numbers and those collection numbers present are cited with each binomial, and will serve to indicate the respective algal habitat from which the collection was made and the person or expedition who made the collection, with the dates. Since the determinations of Schauinsland's collections were made many years ago, many of the names of his species are now relegated to synonymy. In such cases the original names which were listed by Schauinsland or Lemmermann are placed in parentheses under the accepted names with annotations concerning the change included. Those species which represent new algal records from Laysan are preceded by an asterisk.

MYXOPHYTA

Any significant information given in Dr. Francis Drouet's letter to the author is incorporated in the listing below. Since Drouet and Daily, in their "Revision of the coccoid Myxophyceae" (1956), did not have the opportunity to see the holotypes of the coccoid forms determined by Lemmermann from Laysan, they designated them as the types until the specimens could be studied. For the present they place them in a genus or species but tentatively. In the listing below, those coccoid and filamentous Myxophyceae which were not discussed by Dr. Drouet in his letter or by Drouet and Daily (1956) are cited as they appeared in Lemmermann's paper (1905).

*Anacystis dimidiata (Kütz.) Drouet & Daily, 1952: 221.

Local Habitat: Sta. 2 (in salt-water lake).

Anacystis sp.
(Coelosphaeriopsis halophila Lemm.)

Local Habitat: Sta. 1 (in salt-water lake).
Drouet & Daily (1956) tentatively list C. halophila under the genus Anacystis.

Aulosira schauinslandii Lemm., 1905: 622.

Local Habitat: Sta. 1 (epiphytic on Turbinaria ornata)

Calothrix confervicola Bornet & Flahault, 1886: 349.

Local Habitat: Sta. 1 (epiphytic on marine algae)

Entophysalis conferta (Kütz.) Drouet & Daily, 1948: 79.
(Xenococcus laysanensis Lemm.)

Local Habitat: Sta. 1 (epiphytic on marine algae)
Drouet & Daily (1956) tentatively list X. laysanensis under E. conferta.

Entophysalis deusta Drouet & Daily, 1948: 79.
(Chondrocystis schauinslandii Lemm.)

Local Habitat: Sta. 1 (Laysan): Sta. 2 (in salt-water lake); in lake on southeast side growing with Lyngbya aestuarii (19577); Sta. 7 (531).
According to Dr. Drouet, specimen 19577 is a topotype of Chondrocystis schauinslandii.

Gomphosphaeria aponina Kütz., 1836: 151, Drouet & Daily, 1956: 98.

Local Habitat: Sta. 1 (intermixed with marine algae).

Lyngbya aestuarii Gomont, 1893: 147.
(Lyngbya semiplena (C. Ag.) J. Ag.)

Local Habitat: Sta. 1 (Laysan): Sta. 2 (in salt-water lake); in salt-water lake on southeast side (19577); Sta. 7 (531); epiphytic on Sesuvium portulacastrum on north side in salt-water lake, salinity 64 °/oo (607); epiphytic on Cyperus laevigatus on southwest side in salt-water lake, salinity 60 °/oo (608).

This particular alga as determined by Dr. Drouet was growing abundantly as an epiphyte in the salt-water lake. According to Dr. Drouet, specimen 531 is an ecophene (ecological growth-form) usually referred to as Lyngbya semiplena.

Lyngbya meneghiniana (Kütz.) Gomont, 1890: 354.

Local Habitat: Sta. 1 (epiphytic on marine algae).

Microchaete vitiensis Asken. in Bornet & Flahault, 1885: 22.

Local Habitat: Sta. 1 (epiphytic on Liagora coarctata).

*Microcoleus chthonoplastes Gomont, 1892: 354.

Local Habitat: Sta. 2 (in salt-water lake).

Oscillatoria bonnemaisonii Gomont, 1893: 235.

Local Habitat: Sta. 1 (epiphytic on marine algae).

Oscillatoria corallinae Gomont, 1890: 356.

Local Habitat: Sta. 1 (washings from marine algae).

Oscillatoria laetevirens Gomont, 1892: 226.

Local Habitat: Sta. 1 (washings from marine algae).

Phormidium laysanense Lemm., 1905: 619.

Local Habitat: Sta. 1 (epiphytic on Turbinaria ornata).

Schizothrix calcicola (Ag.) Gomont, 1892.
(Lyngbya perelegans Lemm., Lyngbya gloiophila Lemm.,
(Lyngbya mucicola Lemm.)

Local Habitat: Sta. 1 (Laysan) -- all three species listed above in parentheses were listed by Lemmermann; Sta. 2 (in salt-water lake); in salt-water lake on south-east side (19577); epiphytic on Sesuvium portulacastrum on north side in salt-water lake, salinity 64 °/oo (607).

According to Dr. Druoet, specimen 19577 is the topotype of Lyngbya gloiophila Lemm = L. mucicola Lemm. and specimen 607 is the topotype of Lyngbya perelegans Lemm.

Spirulina subtilissima Kütz., 1843: 183.

Local Habitat: Sta. 1 (washings from marine algae).

CHLOROPHYTA

*Acetabularia mobii Solms-Laubach, 1895: 30, pl. 4 (fig. 1); Egerod, 1942: 411, fig. 23i.

Local Habitat: Sta. 9 (549); Sta. 10 (586).
Most of the collections from Station 9 are fertile.

*Bornetella sphaerica (Zanard.) Solms-Laubach, 1893: 92, pl. 9 (fig. 8); Egerod, 1952: 407, figs. 22d-g, pl. 42.

Local Habitat: Sta. 2 (Laysan); Sta. 9 (546)

*Bryopsis pennata Lam., 1809a: 134, fig. 1a-b, pl. 3; Egerod, 1952, 370, fig. 7.

Local Habitat: Sta. 5 (510); Sta. 10(579)
Collections from Sta. 5 were dark green in color with filaments about 5 cm in length. This species was growing in great abundance at this station while very few were found at the other two stations.

*Caulerpa ambigua Okam., 1897: 4, pl. 1 (figs. 3-12); Eubank, 1946: 410, figs. a-b, pl. 22.

Local Habitat: Sta. 9 (548).
Only a few specimens of this species were found along the shore.

Caulerpa racemosa var. laetevirens (Mont.) Weber van Bosse, 1913: 106.

Local Habitat: Sta. 1 (Laysan).
The variety listed above is in question. Eubank (1946) says, "I have seen no specimen which can definitely be referred to var. laetevirens."

*Caulerpa racemosa var. peltata (Lam.) Eubank, 1946: 421, figs. 2r-s.

Local Habitat: Sta. 2 (Laysan); Sta. 7 (523).

*Caulerpa racemosa var. turbinata (J. Ag.) Eubank, 1946: 420, figs. 20p-q.

Local Habitat: Sta. 2 (Laysan); Sta. 9 (541); Sta. 11 (594).
This variety is found in abundance at both habitats. The ramuli appear bright orange in color.

Caulerpa taxifolia (Vahl.) Ag., 1822: 435; Eubank, 1946: 417.
(Caulerpa pinnata (L.) Weber van Bosse sensu Reinbold).

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan).
Eubank (1946) believes that what Reinbold called C. pinnata probably refers to C. taxifolia.

*Caulerpa webbiana Montagne, 1838: 129, pl. 6; Eubank, 1946: 415, figs. 1d-f and 2d.

Local Habitat: Sta. 9 (540).
Forming thick mats along the seaward wall of the tidepool with these mats being exposed during low tide.

*Chaetomorpha antennina (Bory) Kützing, 1849: 379, Boergesen, 1940: 38.

Local Habitat: Sta. 8 (537); Sta. 11 (595).
Forming scattered green tufts at both stations.

*Chlorodesmis hildebrandtii A. & E. S. Gepp, 1911: 16, 137, figs. 74-75; Egerod, 1952; 377, fig. 9b, pl. 34a.

Local Habitat: Sta. 2 (Laysan); Sta. 11 (605B).
A short filament found intermixed with Ceramium fimbriatum and Centroceras clavulatum.

Dictyosphaeria cavernosa (Forsk.) Børg., 1932: 2, pl. 1 (fig. 1); Egerod, 1952: 350, fig. 1e-g.
(Dictyosphaeria favulosa (Ag.) Dcne.)

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan); Sta. 4(19585B); Sta. 10 (588A).

The binomial D. favulosa is now a synonym of D. cavernosa. Specimen 19585B was determined by Dr. Gilbert.

*Dictyosphaeria versluysii Weber van Bosse, 1905: 1944; Egerod, 1952: 351, figs. 1a and 2h-k.

Local Habitat: Sta. 2 (Laysan); Sta. 7 (533); Sta. 9 (542); Sta. 10 (588B).

*Dictyosphaeria sp.

Local Habitat: On coral reef in water about half a meter deep on southeast side of island (19578).

This entity is recorded in Dr. Doty's notebook as belonging to this genus with no specific epithet given. It may very well and probably does fall in one of the two species listed above. The specimen itself cannot be found by the author at present.

*Enteromorpha tubulosa Kützing, 1856: 11; Dawson, 1954: 384, fig. 6a-b.

Local Habitat: Sta. 2 (Laysan); Sta. 6 (520); Sta. 9 (544); Sta. 11 (596).

*Enteromorpha sp.

Local Habitat: Sta. 3 (19579).

This specimen is recorded as such in Dr. Doty's notebook but the specimen itself cannot be found.

*Halimeda discoidea Decaisne, 1842: 91; Hillis, 1959: 352, pl. 2 (fig. 5), pl. 5 (fig. 11), pl. 6 (fig. 11), pl. 7 (figs. 9-10), pl. 8 (figs. 5-8), pl. 11.

Local Habitat: Sta. 2 (Laysan); Sta. 4 (19590); Sta. 5 (509); Sta. 10 (577).

This species is present on all reef flats around the island. Specimen 19590 was determined by Dr. Gilbert and the latter two by Dr. Llewellya Hillis Colinvaux.

*Halimeda lacunalis Taylor, 1950: 91, pl. 51; Hillis, 1959: 349, Pl. 1 (fig. 1), pl. 5 (fig. 6), pl. 6 (fig. 13), pl. 7 (fig. 8), pl. 9.

Local Habitat: Sta. 2 (Laysan).
If the author's determination is correct, this species is a new record for the Hawaiian Islands.

Halimeda opuntia (L.) Lam., 1816: 308; Hillis, 1959: 359, pl. 2 (figs. 7-8), pl. 5 (figs. 3-4), pl. 6 (fig. 6), pl. 7(fig. 3), pl. 10.

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan); Sta. 4 (19586).
Specimen 19586 was determined by Dr. Gilbert.

Microdictyon setchellianum Howe, 1934: 38; Egerod, 1952: 366, figs. 6c-g, pl. 33.
(Microdictyon umbilicatum (Velley) Zanard.)

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan); Sta. 4 (19592); Sta. 7 (529); Sta. 9 (543); Sta. 10 (583); Sta. 11 (606).
The name M. umbilicatum is now a synonym of M. setchellianum. Specimen 19592 was determined by Dr. Gilbert.

*Palmogloea protuberans (Sm. & Sow.) Kützing, 1843: 176.

Local Habitat: Sta. 2 (dredged from bottom of salt-water lake in 5-7 meters of water).
This species was determined by Mr. Newhouse.

*Pringsheimiella acutata (Reinke) Schmidt & Petrack, 1934: 29; Kenyon & Rice, 1959: 248; Taylor, 1960: 51.

Local Habitat: On the molted fur of the Hawaiian monk seal, Monachus schauinslandi Matschie (19593B).
This green alga collected by Dr. Lamoureux was readily seen by the author growing abundantly on the faces and bellies of the sub-adult seals. It seems that the younger seals spend more time in the water and collect a more abundant algal growth. Fig. 9 shows a photograph of the seal on which this species of alga was growing.

*Ulva fasciata Delile, 1813: 153; Bøergesen, 1940: 10.

Local Habitat: Sta. 2 (Laysan); Sta. 6 (521); Sta. 9 (545); Sta. 11 (597).

Fronds deeply cleft with the clefts extending most of the way to the holdfast.

Ulva rigida Ag., 1824: 410.

Local Habitat: Sta. 1 (Laysan).

Gilbert (unpublished manuscript) lists this species as occurring in Hawaii.

PHAEOPHYTA

*Chnoospora minima (Hering) Papenfuss, 1956: 69.

Local Habitat: Sta. 2 (Laysan); Sta. 11 (593).

Dictyota acutiloba J. Ag., 1848: 92.

Local Habitat: Sta. 1 (Laysan).

*Dictyota divaricata Lam., 1809: 331.

Local Habitat: Sta. 9 (553).

*Dictyota friabilis Setchell, 1926: 91, pl. 13 (figs. 4-7) and pl. 20 (fig. 1).

Local Habitat: Sta. 4 (19593); Sta. 5 (513); Sta. 7 (525); Sta. 10 (578).

Growing in clumps with fronds prostrate in nature.

*Ectocarpus breviarticulatus J. Ag., 1847: 7; Setchell, 1924: 171, fig. 37.

Local Habitat: Sta. 9 (555); Sta. 11 (602).

Intertangled tufts with filaments having distinctly hooked branchlets. The slightly oblong plurilocular organs are about 40 μ long and 33 μ wide.

Ectocarpus indicus Sonder in Zollinger, 1854: 3.
(Ectocarpus simpliciusculus var. vitiensis Asken.)

Local Habitat: Sta. 1 (epiphytic on Turbinaria ornata).
In their unpublished manuscript on the Hawaiian Phaeophyta, Dr. Doty and Mr. Newhouse believe that the variety collected by Schauinsland is probably a small form of E. indicus Sonder.

Hydroclathrus clathratus (C. Ag.) Howe, 1920: 590; Dawson 1954: 403, fig. 18b.
(Hydroclathrus cancellatus Bory sensu Reinbold).

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan); Sta. 9 (559).
Doty and Newhouse (unpublished manuscript) believe that what Schauinsland collected was probably H. clathratus.

*Padina crassa Yamade, 1931: 67 and 69.

Local Habitat: Sta. 2 (Laysan).

*Padina japonica Yamada, 1931: 67 and 69, pl. 19 (fig. 2).

Local Habitat: Sta. 9 (558).
Thalli two cells thick throughout with oogonia distributed in concentric rings on the lower surface of the frond.

*Pocockiella variegata (Lam.) Papenfuss, 1943: 467, figs. 1-14.

Local Habitat: Sta. 3 (19581); Sta. 9 (556).

*Ralfsia sp.

Local Habitat: Sta. 2 (Laysan)

*Sargassum echinocarpum J. Ag., 1848: 327.

Local Habitat: Sta. 2 (Laysan).
This sterile specimen is tentatively placed in this species.

*Sargassum obtusifolia J. Ag., 1848: 339.

Local Habitat: Sta. 3 (19580); Sta. 8 (534, 535); Sta. 9 (552).
All of the collections except 534 have long strap-like leaves with the receptacles elongated and appearing warty. Specimen 534 which is sterile has short thick leaves. Proliferations on the primary branches are absent on all the collections. Bladders formed at the apex of short flattened leaves are found on only one of the specimens (535). All collections are about 6 cm high. Although there may be some discrepancy between the description given above and the original description of this species, these specimens will be placed under the above species for the present.

Sargassum polyphyllum J. Ag., 1848: 308.

Local Habitat: Sta. 1 (Laysan).
Lemmermann (1905) also lists S. polyphyllum var. fissifolium Grun. but for the present this variety will be just mentioned here under the specific name.

*Sphacelaria tribuloides Meneghini, 1840: 2; Børgesen, 1941: 41, figs. 18a-c

Local Habitat: Sta. 9 (554).

Turbinaria ornata (Turn.) J. Ag., 1848: 266; Taylor, 1963: 483.

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan); Sta. 9 (551).
Most of the recent collections are made up of juvenile specimens which appear as long intertangled filaments. Only in a few thalli is the peltate apex visible.

Zonaria sp.
(Stypopodium lobatum Kütz.)

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan); Sta. 9 (557); Sta. 10 (584).
The illustration which Kützing, 1859, Tab. Phyc. 9, pl. 63 (fig. 2), shows of S. lobatum looks very much like the undescribed Zonaria which is found in Hawaii.

RHODOPHYTA

Amansia glomerata C. Ag., 1824: 247.

Local Habitat: Sta. 1 (Laysan); Sta. 9 (572).

Amphiroa fragilissima (L.) Lam., 1816: 298; Taylor, 1960: 403, pl. 47 (figs. 1 and 2).

Local Habitat: Sta. 1 (Laysan); Sta. 4 (19591A); Sta. 5 (512); Sta. 10 (589).

*Antithamnion sp.

Local Habitat: Sta. 8 (538 - epiphytic on Chaetomorpha antennina); Sta. 9 (562 - intermixed with Ceramium fimbriatum).

Central axis about 130 u wide with sessile tetrasporangia forming laterally on branches which are about 5 mm long and 20 u wide. Tetrasporangium measured 50 u long and 40 u wide.

*Asparagopsis taxiformis (Delile) Collins & Harvey, 1917: 117.

Local Habitat: Sta. 2 (Laysan); Sta. 3 (19583A); Sta. 9 (563).
Thalli were never found attached but floating in tidepools or as beachdrift.

*Centroceras clavulatum (Ag.) Montagne in Durieu, 1846: 140; Dawson, 1954: 446, fig. 54h.

Local Habitat: Sta. 2 (Laysan); Sta. 7 (530 - associated with Ceramium fimbriatum); Sta. 9 (569 - epiphytic on Microdictyon setchellianum); Sta. 10 (585 - associated with Hypnea sp. 2)

*Ceramium fimbriatum Setch. & Gard., 1924: 777, pl. 26 (figs. 43-44); Dawson, 1954: 446, fig. 55a; Dawson, 1962: 56.

*Champia parvula (C. Ag.) Harvey, 1853; Tab. Phyc. 16, p. 14, pl. 37e-f; Dawson, 1954: 443, figs. 52e, 53.

Local Habitat: Sta. 2 (Laysan).

*Chondria sp. 1

Local Habitat: Sta. 5 (519).

Thalli about 1 cm long with a terminal depression present at the apex. Both short and long branches are formed laterally on the main axis.

*Chondria sp. 2

Local Habitat: Sta. 11 (598).
Branches present on only one side of the main axis.

*Chondrococcus hornemanni (Mert.) Schmitz, 1895: 170.

Local Habitat: Sta. 2 (Laysan); Sta. 9 (568); Sta. 11 (601).
Collections from both stations were floating in tidepools.

*Coelarthrum boergensenii Weber van Bosse, 1928: 473, figs. 207-208.

Local Habitat: Sta. 10 (592).

Corallina sandvicensis Lemm. 1899: 299.

Local Habitat: Sta. 1 (Laysan); Sta. 2 (Laysan).

*Gelidium pusillum (Stackhouse) LeJolis, 1864: 139; Dawson, 1954: 420, fig. 31a-c.

Local Habitat: Sta. 2 (Laysan).

*Gelidium sp.

Local Habitat: Sta. 2 (Laysan).

*Haloplegma sp.

Local Habitat: Sta. 3 (19583B).

*Herposiphonia sp.

Local Habitat: Sta. 10 (581).

*Hypnea cervicornis J. Ag., 1852: 451; Dawson, 1954: 435, fig. 46d; Tanaka, 1941: 240, fig. 13.

Local Habitat: Sta. 2 (Laysan); Sta. 11 (599).
Thallus is more similar to Dawson's illustration than to Tanaka's.

*Hypnea esperi Bory, 1829: 157; Dawson, 1954: 436, fig. 46h-j.

Local Habitat: Sta. 2 (Laysan).

*Hypnea pannosa J. Ag., 1847: 14; Tanaka, 1941: 247, fig. 20.

Local Habitat: Sta. 5 (518); Sta. 9 (566); Sta. 11 (600).
All of the collections formed clumps on the substratum.

*Hypnea sp. 1

Local Habitat: Sta. 7 (526).
Fragment about 1-2 mm high with thallus complanate with few lateral branches present.

*Hypnea sp. 2

Local Habitat: Sta. 10 (580).
Fragment about one centimeter high with no predominate main axis. The majority of the sub-branches are about 2-4 mm long.

*Jania capillacea Harvey, 1853: 84; Dawson, 1952: 116; Dawson, 1954: 432, figs. 41a-b.

Local Habitat: Sta. 9 (567); Sta. 10 (590B).
Calcareous thalli forming clumps with the individual thallus ranging from 66-120 μ in width.

*Jania decussato-dichotoma (Yendo) Yendo, 1905: 37; Dawson, 1952: 117, pl. 27 (fig. 3); Dawson, 1954: 430, fig. 40f.

Local Habitat: Sta. 4 (19587).

*Jania mexicana Taylor, 1945: 197.

Local Habitat: Sta. 2 (Laysan).

*Jania micrarthrodia Lam., 1816: 271, pl. 9 (fig. 5a-b); Dawson, 1956: 49, fig. 42.

Local Habitat: Sta. 2 (Laysan).

*Jania natalensis Harvey, 1847: 107; Dawson, 1952: 118, pl. 27 (figs. 1-2).

Local Habitat: Sta. 7 (522).
Thalli about 3 cm high with narrow erect branches. Intergenicula more or less uniform in diameter throughout, with short branches arising from intergenicula.

*Jania ungulata Yendo, 1902: 27, pl. 3 (figs. 7-8) and pl. 7 (fig. 8).

Local Habitat: Sta. 4 (19589); Sta. 10 (591).
Thalli about 3 cm high with flat swellings at tips of terminal branches.

*Laurencia corymbosa J. Ag., 1863: 716; Dawson, 1954: 458, fig. 61f.

Local Habitat: Sta. 9 (573).
Rigid thalli about 2-3 cm high.

Laurencia obtusa (Huds.) Lam., 1813: 130; Taylor, 1960: 626; Yamada, 1931: 222, pl. 16 (figs. a-e) and pl. 17 (figs. a-c).

Local Habitat: Sta. 1 (Laysan); Sta. 4 (19588); Sta. 5 (514); Sta. 7 (524); Sta. 9 (564); Sta. 10 (582); Sta. 11 (603).
Forming thick red mats completely covering the high coral ledges that were accessible to spray from waves.

*Laurencia perforata (Bory) Mont., 1840: 155; Yamada, 1931: 193, figs. a-b, pl. 3 (fig. b).
(Laurencia vaga Kütz.)

Local Habitat: Sta. 1 (Laysan).
Yamada (1931), after examining a cotype collected by Vieillard in New Caledonia, says that Kützing's L. vaga is probably L. perforata.

*Laurencia pygmaea Weber van Bosse, 1913a: 122, pl. 12 (fig. 6); Yamada, 1931: 201.

Local Habitat: Sta. 11 (604).

*Laurencia sp. 1

Local Habitat: Sta. 9 (565).

*Laurencia sp. 2

Local Habitat: Sta. 9 (560).

*Laurencia sp. 3

Local Habitat: Sta. 5 (515).

*Laurencia sp. 4

Local Habitat: Sta. 2 (Laysan).

*Laurencia sp. 5

Local Habitat: Sta. 2 (Laysan).

Liagora coarctata Zanard.

Local Habitat: Sta. 1 (Laysan).

*Liagora kahukuana Abbott, 1945: 149, fig. 2.

Local Habitat: Sta. 3 (19584).
A large male thallus about 14 cm long. This specimen falls within Abbott's description of this species.

Liagora valida Harv., 1852: 138, pl. 31A (figs. 1-5).

Local Habitat: Sta. 1 (Laysan).

*Liagora sp. 1

Local Habitat: Sta. 2 (Laysan).

*Liagora sp. 2

Local Habitat: Sta. 2 (Laysan).

Lithothamnion sp.

Local Habitat: Sta. 1 (Laysan)

*Peyssonelia sp.

Local Habitat: Sta. 2 (Laysan)

Polysiphonia polyphysa Kütz. 1863: 20.

Local Habitat: Sta. 1 (Laysan).
Menez (1964) says that he could find no specimens of this species in any of the Hawaiian collection. De Toni (1900) believes that this specimen is probably P. ferulacea.

*Polysiphonia sphaerocarpa Bøerg., 1918: 271, figs. 267-271.

Local Habitat: Sta. 8 (539).
Determination made by Dr. Hollenberg.

*Polysiphonia sp.

Local Habitat: Forming deep red tufts on the neck of a sea turtle, Chelone mydas (609).
Filaments arising from a prostrate axis.

*Porolithon sp.

Local Habitat: Sta. 7 (528); Sta. 10 (587).
White calcareous alga covering portion of reef.

*Pterocladia parva Dawson, 1952: 77, pl. 6 (fig. 2).

Local Habitat: Sta. 5 (517).

Summary of Algal Collections

Below is a table summarizing the number of algal species or varieties listed in this paper in each of the major divisions collected by the four collectors from Laysan Island.

Collectors	Myxophyta	Chlorophyta	Phaeophyta	Rhodophyta	Total
Schauinsland (1896-1897)	15	6	6	10	37
Tanager Exp. (1923)	5	14	7	17	43
Lamoureux (1961)	3	7	3	7	20
Tsuda (1963)	3	15	11	28	57

Of these collections, 72 species or varieties are new published records for Laysan. These new records consist of 2 in the Myxophyta, 18 in the Chlorophyta, 11 in the Phaeophyta and 39 in the Rhodophyta.

VASCULAR PLANTS

The following is an annotated listing of the twenty-two species of vascular plants collected from Laysan by the author during his visit there in December 1963. Lamoureux (1963) elaborated on the various vegetation patterns and associations that may be found on the island. From reading this account, the only significant change noticed was that the water from the salt-water lake had risen considerably probably due to heavy rainfall. This rise in water had caused most of the Sesuvium-Cyperus-Heliotropium association near the edge of the lake to be covered with water. In this listing are two species, determined by Dr. Lamoureux, which were not found in 1961. They are preceded by an asterisk. All of the other determinations were made by the author and later verified by Dr. Lamoureux. Three sets of these plants were prepared and deposited respectively in the herbarium at the Bishop Museum, herbarium at the University of Hawaii and the Hawaii State Fish and Game Division.

Casuarina equisetifolia L.

One tree (Fig. 5) about 5-7 meters high was present on the west side of the island. The Hawaiian terns (Anous tenuirostris melanogenys) were using this tree as a nesting site.

Cocos nucifera L.

Nineteen coconut trees were present on the island. The twelve trees at the northwest side of the lake (Fig. 10) seemed in fine condition with the water from the lake not reaching the base of the trees. However, the seven trees on the southeast edge of the lake (Figs. 11-12) had about 15 to 30 cm of water around their bases. The older leaves on most of these southeastern trees were wilting.

*Conyza bonariensis (L.) Cronq.

This plant was growing just south of the campsite (northwest side of island). This was the only area in which these plants were found. All specimens of this weed which could be found were uprooted by Mr. Ronald Walker.

Cynodon dactylon (L.) Pers.

Appearing as a thick green carpet on the northeastern side near the edge of the lake. The Laysan albatross (Diomedea immutabilis) were using this area as a nesting site. During the day many Laysan teal (Anas wyvilliana laysanensis) were seen by the author in this area.

Cyperus laevigatus L.

This sedge was growing abundantly on the outer edge of the lake, as well as in the lake itself (Fig. 13). Numerous albatross eggs were found abandoned on those sedges which had been flooded by the lake.

Cyperus pennatiformis var. bryanii Kükenthal

This variety is endemic to Laysan Island. It was only seen in a restricted area near the southern edge of the lake (Fig. 7).

Eragrostis variabilis (Gaud.) Steud.

Growing in bunches (Fig. 6) throughout the island, making up the major vegetation.

Fimbristylis cymosa R. Br.

Scattered bunches occurring throughout the island.

Heliotropium curassavicum L.

Only one specimen was found on the southwest side of the island in association with Eragrostis variabilis and Ipomoea pes-caprae. No sign of this species was found near the lake's edge, where Lamoureux (1963) had described it as occurring in abundance. This was probably due to the rise of the water in the lake which apparently covered over the area where this species flourished.

Ipomoea indica (Burm.) Merr.

Occurring in small patch on southwest side of island, halfway between the lake and the beach. This species could not be found elsewhere even though an extensive search was made for it. None of the specimens found were flowering.

Ipomoea pes-caprae (L.) Sw.

This low creeping vine was found in abundance near the lake. Numerous lavender flowers were present.

Messerschmidea argentea (L. f.) Johnston

Only one tree (Fig. 4), about 2 meters high, was present on the beach near the Scaevola bushes about fifty meters north of main boat entrance. At a distance this tree appeared dead because only the bare trunk and branches were seen. On closer observation, new shoots were seen arising from the base of this trunk and in the axils of the branches.

Nama sandwicensis var. laysanicum Brand

Appearing as flat patches on the beach mostly concentrated on the northwest side of the island.

Nicotiana tabacum L.

Growing about 1-1.5 meters high, found most abundantly on the western side of island (Fig. 8).

Pluchea indica (L.) Less.

Forming entangled bushes predominantly on the northern side of the island near the lake's edge.

Portulacea oleracea L.

Found on the southwestern side of island near the beach. None of these plants were flowering.

Scaevola taccada (Gaertn.) Roxb.

Abundant near the beach around the island. In many instances the Hawaiian monk seal (Fig. 9) could be seen sleeping among the bushes.

Sesuvium portulacastrum L.

Most plants of this species were under water at the lake's edge but, although submerged, they appeared to be living. This species is easily recognized by its bright red stem and small lavender flowers.

Sicyos microcarpus Mann

Flowering specimens of this species were only found on the south side of the island about a hundred meters from the edge of the lake. It is quite possible that the other two species collected by Dr. Lamoureux in 1961 were also present, because this genus was also abundant on the northern side of the island where Dr. Lamoureux had found all three species. Since no flowers or fruits were found on these northern plants, an accurate species determination could not be made. /Lamoureux' record of S. microcarpus was accidentally omitted from ARB 97 p. 6. Ed./

*Solanum nigrum L.

Only two individual plants were found on the trail leading from the beach to the campsite. Dr. John W. Beardsley, Jr., collected a specimen of this plant on Laysan in 1962.

Tribulus cistoides L.

Growing as a low creeping plant (Fig. 8) abundant throughout the island. This species was easily recognized by its thorny green fruits and pinnately compound leaves.

Seeds

The following is a list of the five species of seeds collected on the beach from Laysan with the number of each in parentheses. They were determined by Miss Marie Neal.

Caesalpinia crista L. (1)

Cocos nucifera L. (numerous)

Dioclea violacea Mart. (1)

Mucuna gigantea DC (5)

Mucuna urens DC (1)

Seed Planting

Six species of seeds were planted by Mr. Ronald Walker of the Hawaii State Fish and Game Division near the northwestern edge of the lake during our visit there in 1963. Plantings were made at intervals of ten paces due north from the northernmost coconut tree in the following order.

1. Lepidium o-waihiense C. & S.
2. Cenchrus agrimonioides var. laysanensis F. Br.
3. Achyranthes splendens var. reflexa Hillebr.
4. Chenopodium oahuense (Meyen) Aellen
5. Solanum nelsonii Dunal
6. Lipochaeta integrifolia (Nutt.) Gray

All of the above species or varieties of seeds were collected from Kure, September 1961, with the exception of Chenopodium oahuense which was collected from Nihoa, December 1961. Another planting was made forty-five paces due west of photostation C-3 (marker used by the personnel of the Hawaii State Fish and Game Division for survey purposes) which is located on the northwestern side of the island near the lake's edge. Here the seeds were planted at random.

The seeds of Chenopodium, Solanum, and Sicyos microcarpus planted by Mr. R. Kramer in June 1962 apparently failed to germinate as no specimens could be found at the area of the plantings.

SALINITY DATA

Seven salinity stations were made along the shore of the beach while fifteen salinity stations were made in the salt-water lake. White foam (Figs. 11-12) resembling fine soap suds could be seen accumulated all along the southeastern and eastern edge of the lake. At times this foam was over 30 cm deep and was found to be tasteless. According to Dr. Philip Helfrich, Hawaii Marine Laboratory, similar foam also occurs on the edge of the salt-water lagoon on Christmas Island, one of the islands in the Line Group. Riley (1963) describes a mechanism by which such material is formed, at least in part, by adsorption of dissolved or colloidal material on bubbles and other available surfaces. Once formed the aggregates tend to increase in size, either by agglutination or by further adsorption. The wind blowing from the northwestern side of the island caused this foam to accumulate on the opposite shore.

Two of the fifteen samples from the lake were taken within that area designed as "spring" as shown on the map made by the Tanager Expedition, April 1923. This "spring" is supposedly located on the northeastern edge of the lake, which is at present continuous with the main lake because of the rise in water except for the long row of Pluchea bushes partially separating the "spring" from the main lake. The water from the "spring" was found to be less saline than the water from the main lake, probably because of mixing with the fresh water lens in this particular area. It will be noticed that the lake water is much more saline than the surrounding sea water, and that even the "spring" is saltier than the sea.

The salinity data obtained by the author are listed below. All samples were taken from the surface in about one meter of water. See Fig. 1 for the location of each of the salinity stations (encircled numbers).

I. Water from Ocean (surface samples)

1. Slightly wave-washed bench---------- 35.01 °/oo
2. Tidepool on coral ledge---------- 35.19 °/oo
3. Sandy area between shoreline and reef------ 35.14 °/oo
4. Calm shore over reef---------- 35.20 °/oo
5. Wave-washed shore---------- 35.17 °/oo
6. Slightly wave-washed bench---------- 35.12 °/oo
7. Shore off NW boat entrance---------- 35.15 °/oo

II. Water from Lake (surface samples)

8. Over Cyperus laevigatus ---------- lost
9. Over Cyperus laevigatus---------- 62.00 °/oo
10. Over Cyperus laevigatus---------- 60.00 °/oo
11. Over Lyngbya aestuarii and Cyperus laevigatus-- 62.00 °/oo
12. Near Cocos nucifera ---------- 61.00 °/oo

13. Over Cyperus laevigatus---------- 60.00 °/oo

14. In puddle, one foot deep---------- 12.00 °/oo

15. Over Sesuvium portulacastrum---------- 60.00 °/oo

16. Over Sesuvium portulacastrum---------- 62.00 °/oo

17. Over Cyperus laevigatus---------- 64.00 °/oo

18. Over mud flat---------- 59.00 °/oo

19. Over mud flat ---------- 80.00 °/oo

20. Over mud flat---------- 66.00 °/oo

III. "Spring" on NE side of Lake (surface samples)

21. Flooded "Spring"---------- 43.00 °/oo

22. Flooded "Spring"---------- 53.00 °/oo

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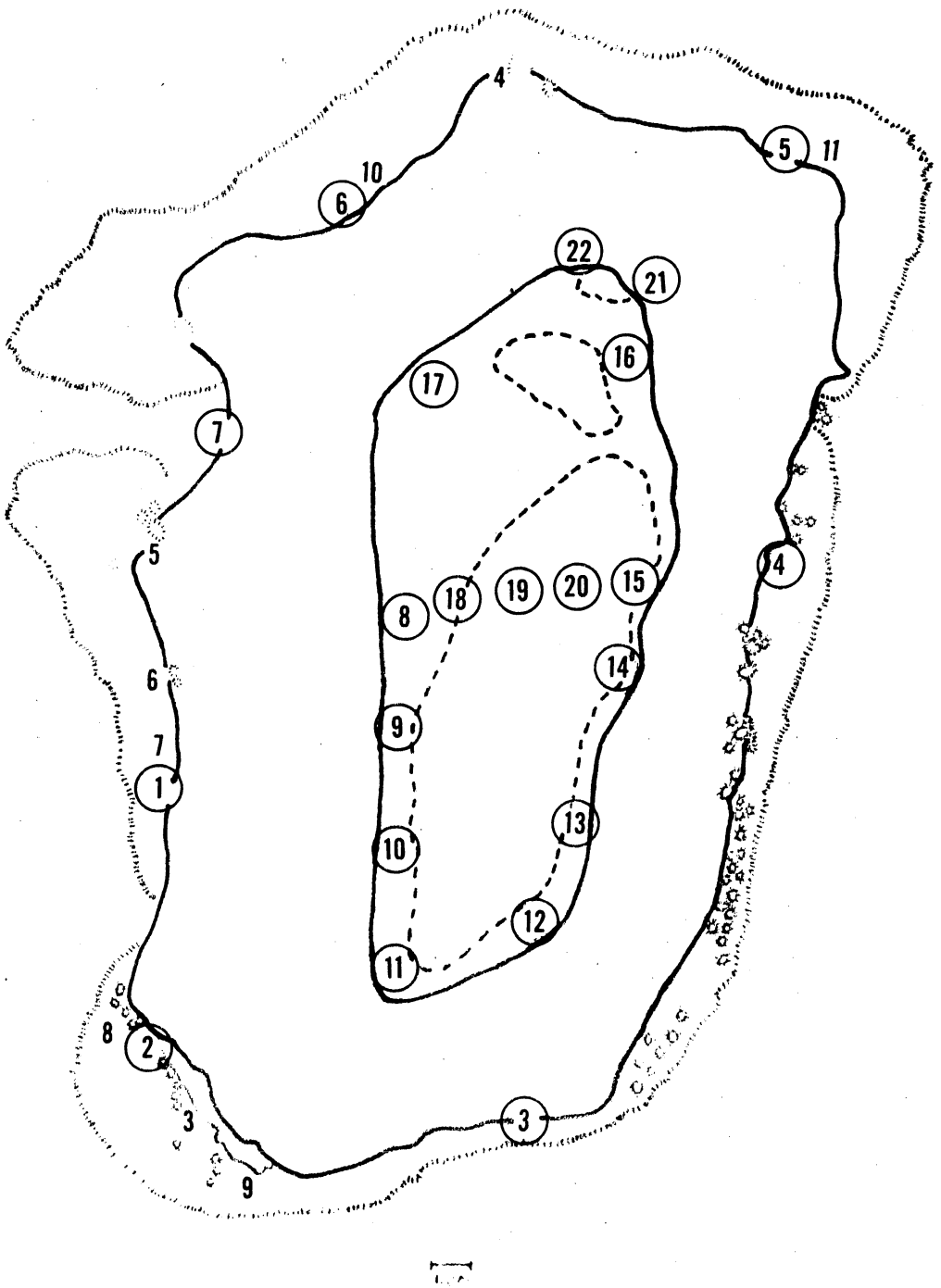
Fig. 1 Map of Laysan Island showing the location of the nine recent algal collecting stations and the twenty-two salinity stations (encircled numbers) taken during the author's 1963 visit to the island. The solid line within the island represents the 1963 water level of the salt-water lake while the inner dotted line represents the 1961 water level. The "spring" can be seen on the northeast corner of the lake.

LAYSAN ISLAND

Dec., 1963

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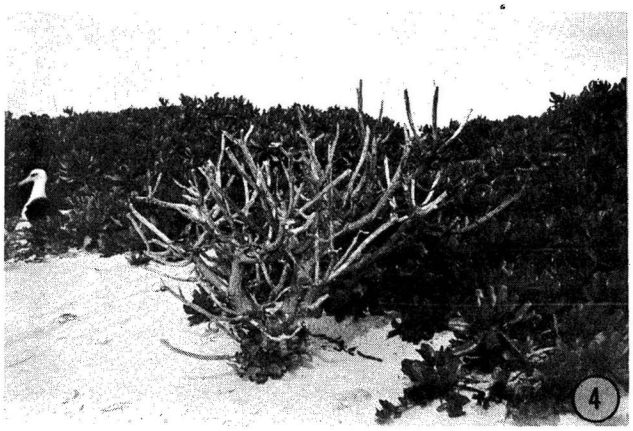
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All photographs were taken on Laysan Island in December 1963.

Fig. 2. View of the large coral ridge on the southwest side of island, during high tide, from which most of the algal collections were made (Stas. 7 and 8).

Fig. 3. View of a sandy area along the west shore facing north. This photograph was taken between algal collection stations 5 and 6. In this area very few algal specimens could be found.

Fig. 4. The only specimen of Messerchmidea argentea on the island with Scaevola taccada in the background. Notice the new leaves appearing at the base of the trunk.

Fig. 5. The only specimen of Casuarina equisetifolia on the island with Eragrostis variabilis and Scaevola taccada in foreground.

Fig. 6. View from the west side of the island facing the coconut trees on the southeastern side of the island, showing the great abundance of the bunch grass, Eragrostis variabilis.

Fig. 7 A small patch of Cyperus pennatiformis, a species endemic to Laysan, on the southern side of island. The coconut trees can be seen in the background.

Fig. 8 A few specimens of Nicotiana tabacum with Tribulus cistoides creeping close to the ground on western side of island.

Fig. 9 A Hawaiian monk seal, Monachus schauinslandi, and a Laysan albatross, Diomedea immutabilis, in Scaevola bush.

Fig. 10 The twelve coconut trees on the northwest side of the lake.

Fig. 11 The seven coconut trees on the southeast edge of the lake flooded by water from the lake. The white layer on the surface of the lake was the tasteless foam mentioned in the discussion under the salinity data.

Fig. 12 A closer view of the coconut trees on the southeastern edge of the lake, showing the foam and the water from the lake flooding the bases of the trees.

Fig. 13 View of the northeastern side of the lake facing south, showing the flooded area. Notice how the albatrosses have built up their nests trying in vain to save their eggs. Numerous abandoned eggs were found on the bottom of the lake in about six to twelve inches of water.


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